

## **Abstract**

Fishing is one of the oldest avocations of man, older than even hunting and farming. In the beginning, man used his bare hands to collect/capture fish and other aquatic animals found along the shores of lakes, rivers, and seas. But, as time passed, many changes occurred in the mode and pattern of fishing. Planned fishing operations are believed to have come into force with the emergence of tribal units from family units. The evolution of fishing gears proceeded step by step from the capture of individual fish to catching them in bulk. Subsequently gears progressively larger in size and sophistication came to be introduced.

Fish is considered to be exceptionally nutritious as it is rich in easily digestible animal protein for which there exists hardly any substitute. Nutritionists consider fish as a valuable and effective supplement to a high cereal diet. Empirical findings also attest that fish consumption can reduce disability and the incidence of heart diseases (Sen Gupta, 1984).

Fishing characteristically enjoys some added advantages over agriculture. As an economic activity, fishing is quick yielding as compared to agriculture, since the former involves a lesser time lag between efforts and results. In the case of most agricultural crops, it takes at least three months to reap the harvest after sowing. By contrast, in fishing output is instantaneous with effort. Further fishing resources unlike agriculture are renewable and replenishable year by year, which therefore forms a self-sustaining "fund" of resources that can be harvested continuously within maximum limits of exploitation (James, 1972). Productivity is also found to be appreciably higher in fishing when compared to agriculture or animal husbandry.

As an industry with wide backward and forward linkages, the employment and income generation potential of fisheries has increased unprecedentedly in recent decades. Technological innovations in fishing, processing, and marketing have given rise to a host of subsidiary occupations related to boat building, net making, fish processing so on; all these leading to industrial diversification and further strengthening of the economy. In recent times, of all, what has particularly enhanced the economic importance of fisheries is its potential in earning foreign exchange.

The fishing sector occupies an important place in West Bengal's economy as a source of cheap but nutritious food, means of livelihood for thousands of the poor, and an important source of foreign exchange earnings. West Bengal ranks as the second-largest fish producer

state in the country after Andhra Pradesh. The state also has the distinction of being a pioneer state in India in terms of fish seed production. The fisheries in West Bengal are comprised of both marine and inland fisheries. However, the state is well known for inland fisheries being made up of freshwater as well as brackish water fisheries. Despite having uninterrupted growth of inland fisheries over the years, there is a gross imbalance between the supply and demand of fish to a considerable extent within the state. The shortfall of supply relative to demand is made up by the import of fish from other states, especially from Andhra Pradesh. This necessitates developing and extending fisheries' economic activities in different directions and locations to increase production further to mitigate the shortfall. In the state, about 78% of the fish caught is sold as fresh or chilled food for the population and inland landing centers. About 6% of the catch is used for drying and curing, 13% to produce frozen fish, and 4% to reduce the yield into fish meals. In the wake of changing lifestyles, value-added fishery products of different descriptions as convenience food are also gaining popularity in the markets. So it can be said that the fishery sector has an important role in the development of the state's economy.

The fisheries sector constitutes an important component of the regional rural economy of North Bengal. As the fishery resource can re-generate itself naturally in a time frame that is relevant for human exploitation, its commercial production and harvesting can provide massive scope for regional economic development on a sustainable basis. The development of the fisheries' economic activities in different directions can lead to income and employment generation for the rural population on a significant scale. The North Bengal fishery is mainly comprised of inland fishery resources - the pond fisheries are the more dominating form among all of them. The region is rich in water resources. The total water area available for the fishery sector is at present 41752 hectares. The fishery sector of the region registered 199277 metric tons of fish production in 2017-18, which is 12.8 percent of the total fish production in West Bengal during this period. The Fish production in North Bengal has grown moderately well from 1443 metric tons in 2010-11 to 1742 metric tons in 2017-18. This is perhaps due to the expansion of the area under the pond. The fishery sector of the region has also been undergoing a steady transformation from traditional fishing activity to commercial activity over the years. Despite these facts, the level of production and productivity are far from adequate, leaving a large gap between actual and potential output. The region is yet to tap the vast growth potentials of the production of fish, mainly from pisciculture.

Also, the fish marketing system in North Bengal has been discussed here. This study has been conducted here to assess the market efficiencies indicators such as gross marketing margin (GMM) and percentage share of fishermen in the consumer rupee (PSFCR) among other indicators. The highest price spread is supposed to be observed in the longest marketing channel due to the involvement of the highest number of marketing intermediaries. In our sample, Darjeeling has a higher price spread when compared to other districts for most of the species. Thus, the marketing efficiency in terms of GMM is relatively lower in Darjeeling in comparison to other districts of North Bengal. Besides GMM, the percentage share of fishermen in the consumer rupee (PSFCR) has been calculated for the different species at the district level with the objective to make an assessment of the level of marketing efficiency across the districts.

Efficiency in production is a way to ensure that the products of firms are produced in the best and most profitable way. To prevent the wastage of resources, efficiency is of great importance for every sector of the economy. The study is to examine the technical efficiency of pond fishery using the stochastic frontier model in the northern region of West Bengal. The estimated stochastic frontier model reveals that investment in labour, organic fertilizers, fish fingerling, and land area can increase the return from fish production. The result shows that technical efficiency ranges from 83 to 100 percent with a mean efficiency of 94 percent implying that average fish farmers in the study area are performing below the maximum possible production level by a shortfall of about 6 percent. The study recommends that the use of labour and organic fertilizers (i.e. cow dung) should be made available, to transform traditional rearing practices into more productive scientific methods. Also, the land area should be extended and more fish fingerling should be used to increase the production of fish in the study area. Aquaculture needs to be integrated with agriculture, piggery, duckery, etc. Nowadays, pisciculture activity is mixed with piggery or duckery activity for better viability of the pisciculture scheme. The product of the piggery or poultry may be utilized for manuring the water of the ponds or tanks. These will provide basic nutrients to the water, which also helps in maintaining the food chain of the fish. No extra expenditure for manure or supplementary feed will be required.

In this study, the level of technical efficiency of the pond fishery in North Bengal has been estimated using the CCR and BCC DEA models. In the Uttar Dinajpur district, the minimum and maximum TE scores were estimated as 37.50 percent and 100 percent, respectively. On average, the TE score of the sample fish farmers in this district was estimated at 85 percent

which is fairly high. The result indicates that the pond fish farmers could reduce their level of input use by approximately 15% to achieve full TE given the current level of technology. In the Dakshin Dinajpur district, on the other hand, the minimum and maximum TE scores were estimated as 34 percent and 100 percent, respectively. On average, the TE score of the sample fish farmers in this district was estimated at 77 percent which is smaller compared to that value of 85 percent of Uttar Dinajpur district. This result implies that there is still sufficient room for improvement of the TE of pond fish farmers in the study region. More specifically, farms have the potential to reduce their physical inputs used by 23 (= 100 – 77) percent, and still maintain their same production levels. Comparing the magnitudes of standard deviation estimated for the two districts, it could be inferred that variability in TE score is much lower in Uttar Dinajpur district (s.d of 18.38) in comparison to Dakshin Dinajpur district (s.d of 23.40).

The finding of the study also reveals that the mean technical efficiency of the sampled pond in the case of the combined dataset is at 74 percent for the BCC model. This implies that the production from the pond fishery has a chance of 27 percent to increase technical efficiency if the technology of fish farming is characterized by variable returns to scale (VRS). It is more than one-third (35.38) percent of the pond fishery farmers could be identified as fully technically efficient farms in the BCC model. This suggests that there is a need for the intervention of the government, particularly the Department of Fisheries to take appropriate measures to increase productivity and the technical efficiency level among pond fishery farmers.